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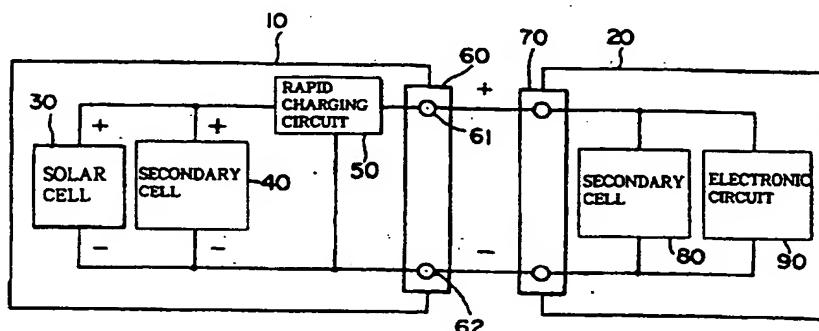
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## (54) Portable power supply

(57) A portable power supply 10 has an electrical generator 30, a charge store 40, and a rapid charging circuit 50 for charging a secondary cell 80 in a portable electronic device 20. The supply 10 thus allows the device 20 to be rapidly recharged and then disconnected from the supply 10, whereby portability of the device 20 is not sacrificed. The generator 30 may be a manually operated generator, a fuel cell, or particularly a solar cell. The charge store 40 may be a capacitor, or particularly a secondary cell. The circuit 50 may provide constant current and/or constant voltage charging. The charge state of the cell 40 may be indicated by a display (41c, or 42c, Figs.8,9) controlled by a circuit responsive to cell current and/or voltage. An LED (45, Fig.13) may be provided to indicate that the solar cell 30 is generating. A discharger (43 or 44, Figs.10-12) may be provided for discharging cell 40 to prevent memory effect. The discharger may be controlled manually, or by means of a circuit responsive to the number of times the cell 40 has discharged to the device 20, or responsive to integration of the charge and/or discharge time periods of the cell 40. The cell 40 may be charged from the solar cell 30 via a constant current or constant voltage charger circuit (46, Fig.14). The cell 40 may be housed in a case (11, Figs.5,6) having a fold-up solar cell array (12). The supply 10 may have a spring-loaded reel (17, Fig.7) for winding up a power cord (15) by means of which the supply 10 can be releasably connected to the device 20.

The portable device 20 may be a communication device, such as a telephone, or a personal computer.

FIG.2



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FIG.1 (PRIOR ART)

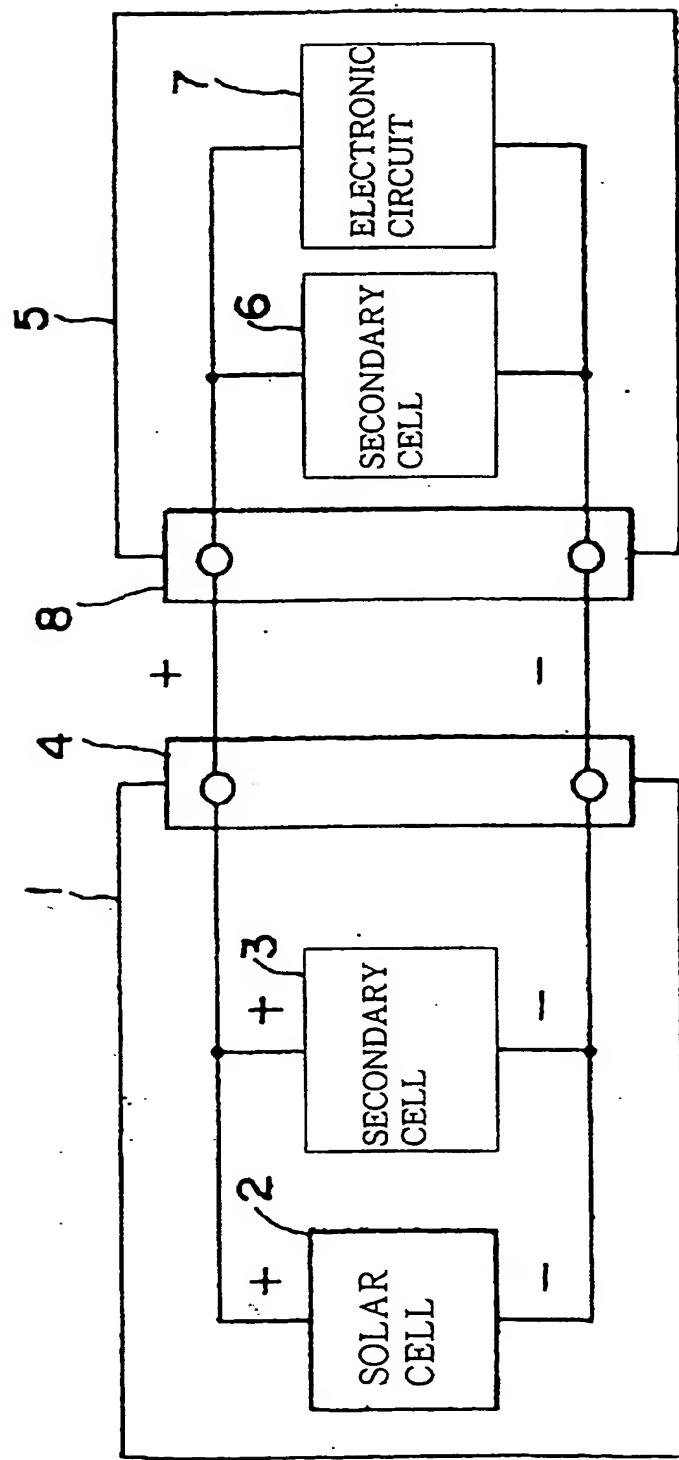


FIG.2

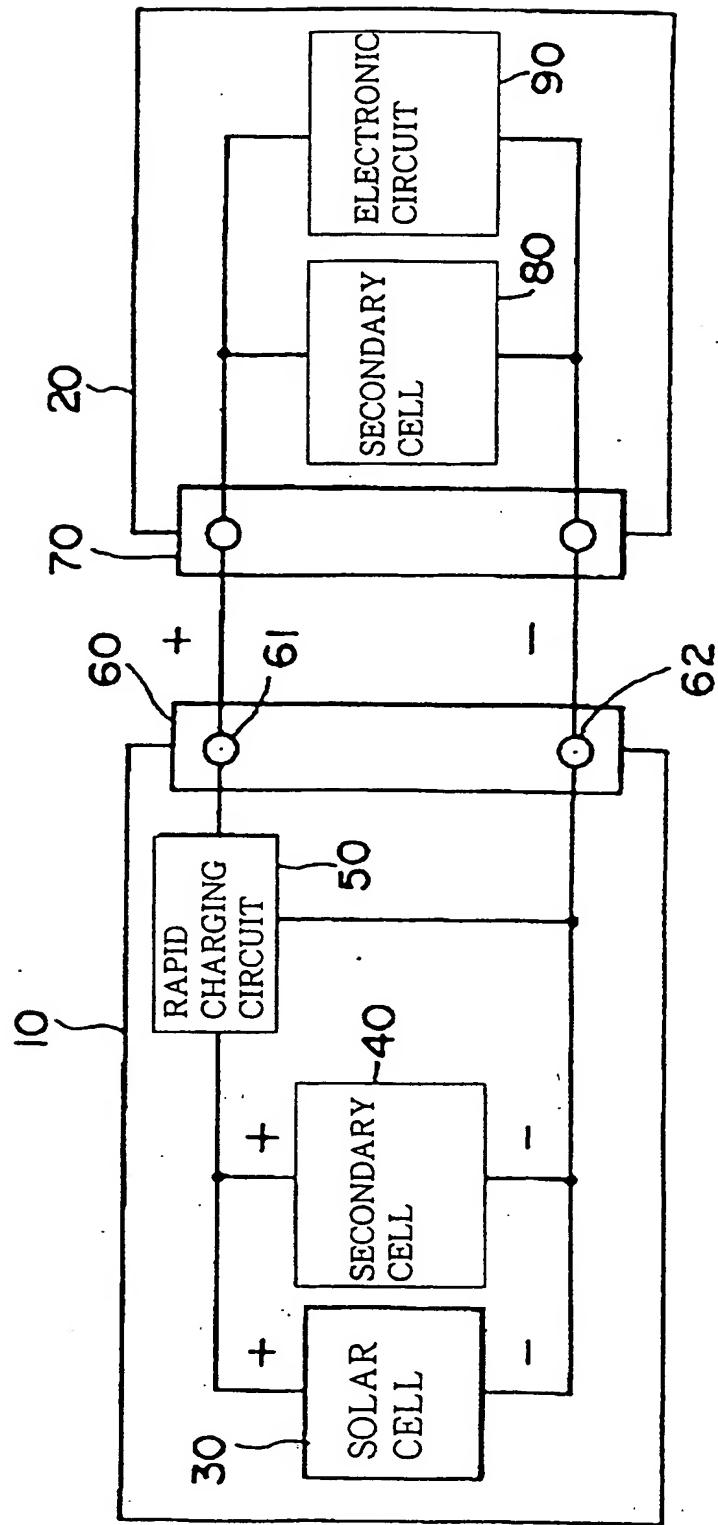


FIG.3

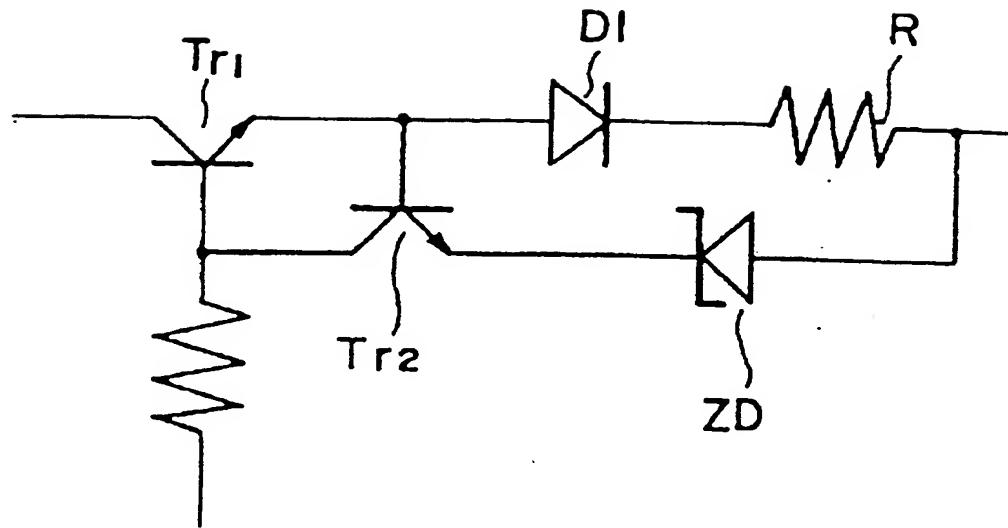


FIG.4

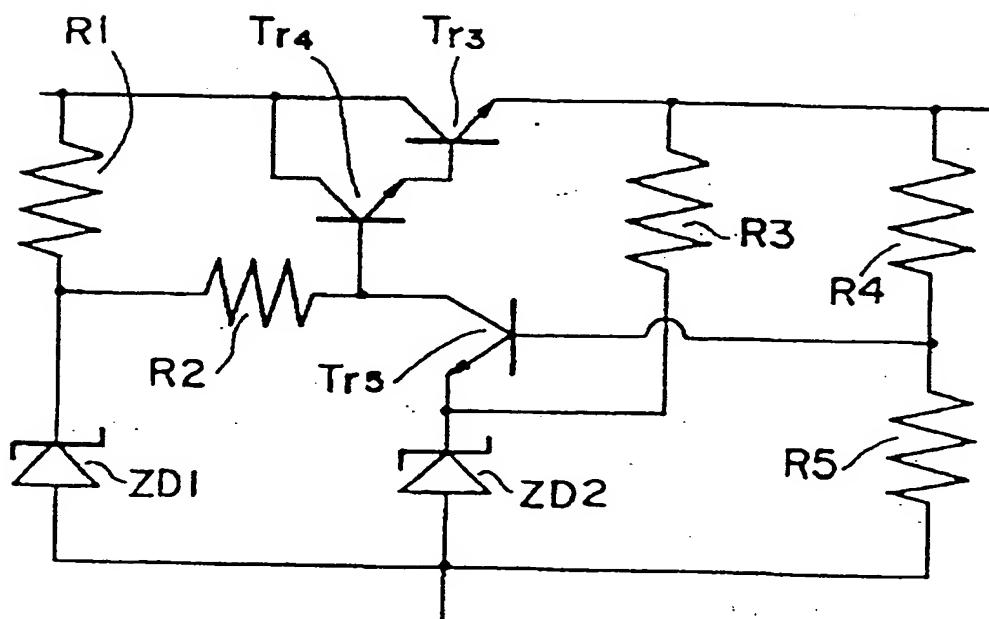
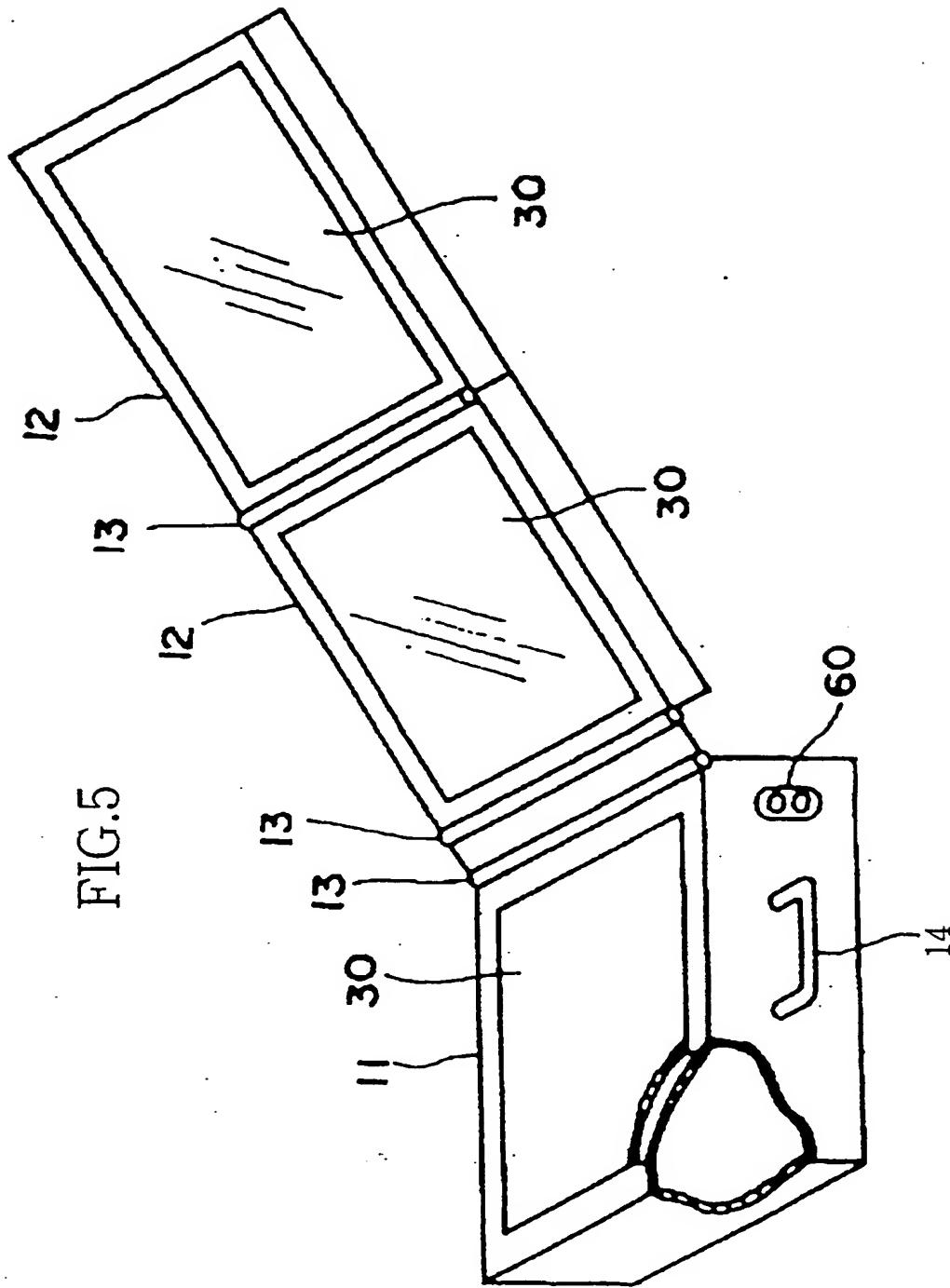


FIG.5



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FIG.6

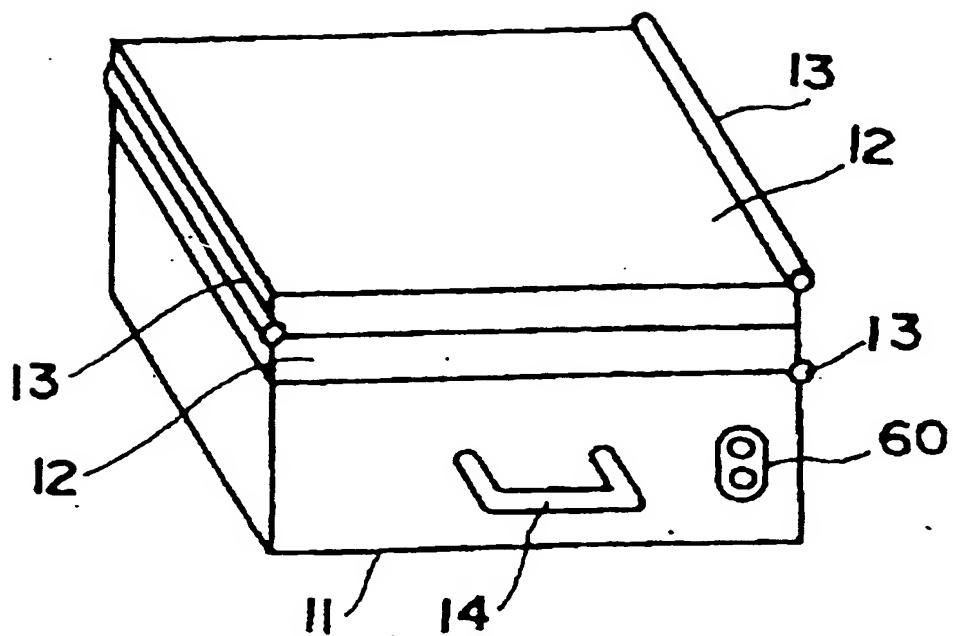


FIG.7

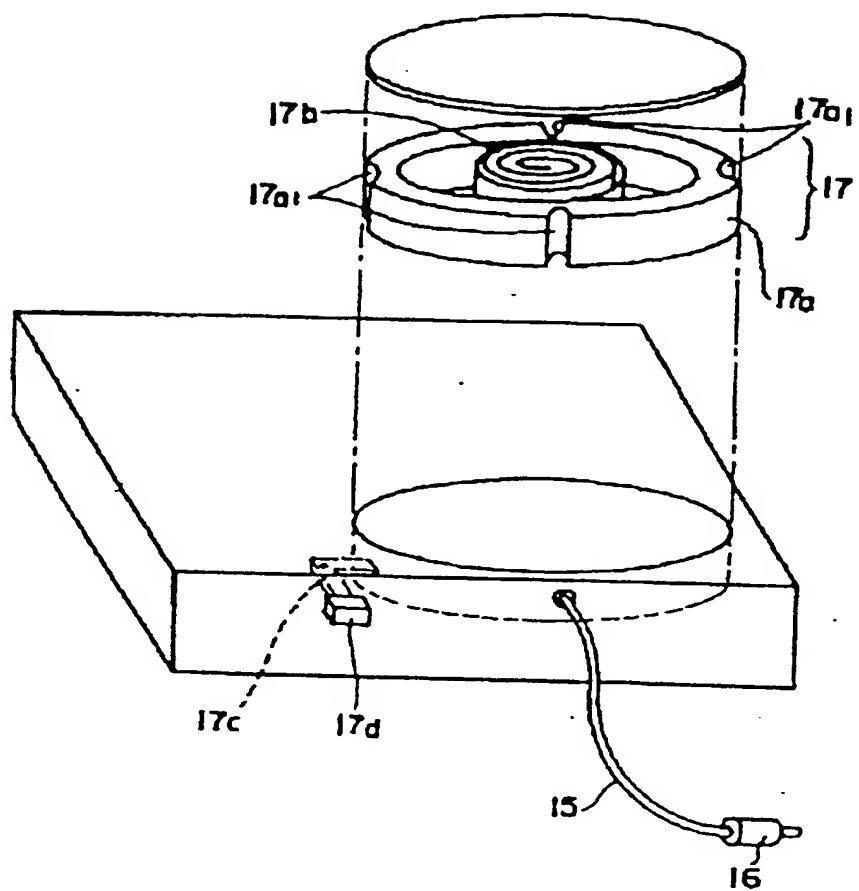


FIG.8

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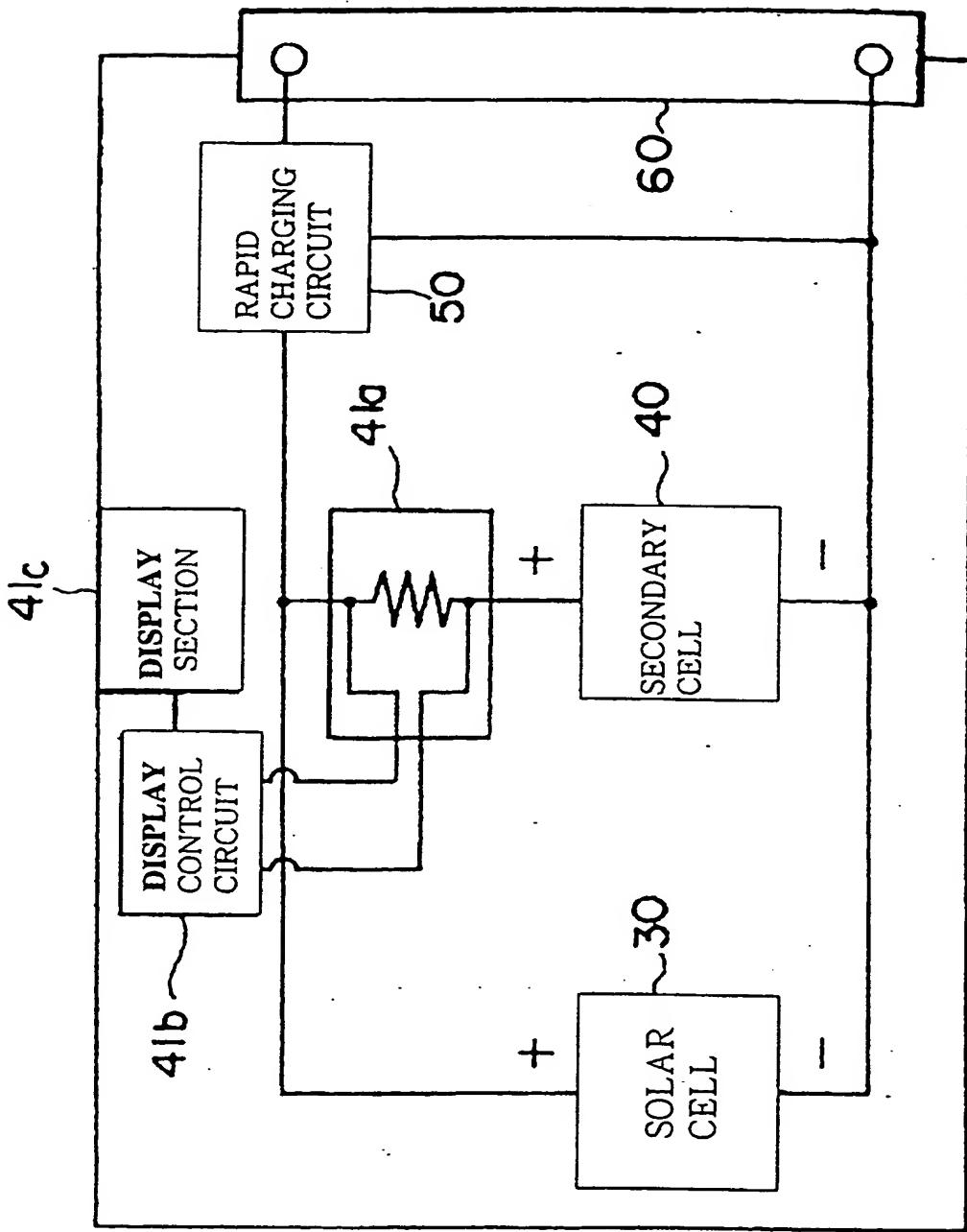


FIG.9

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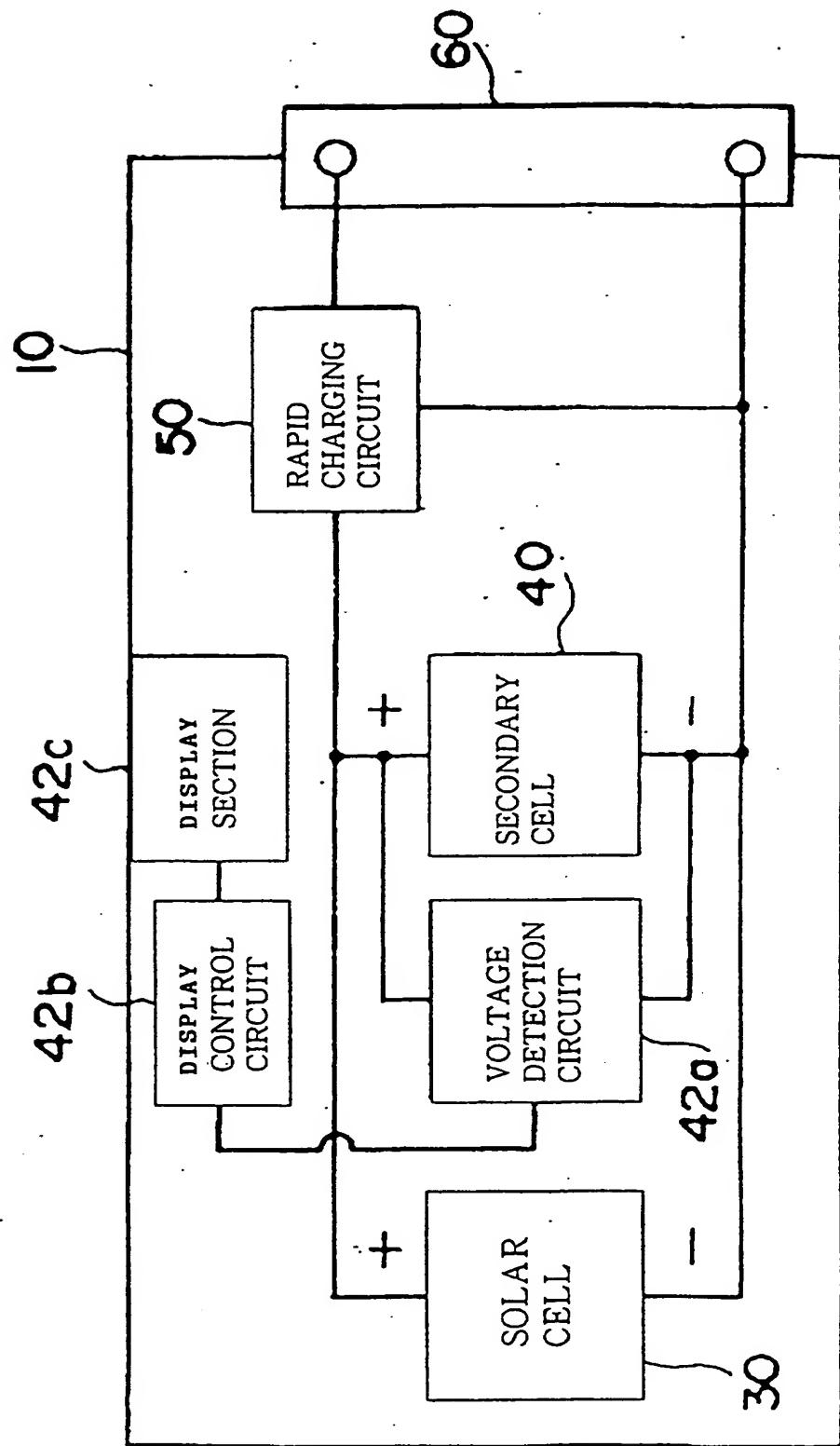


FIG.10

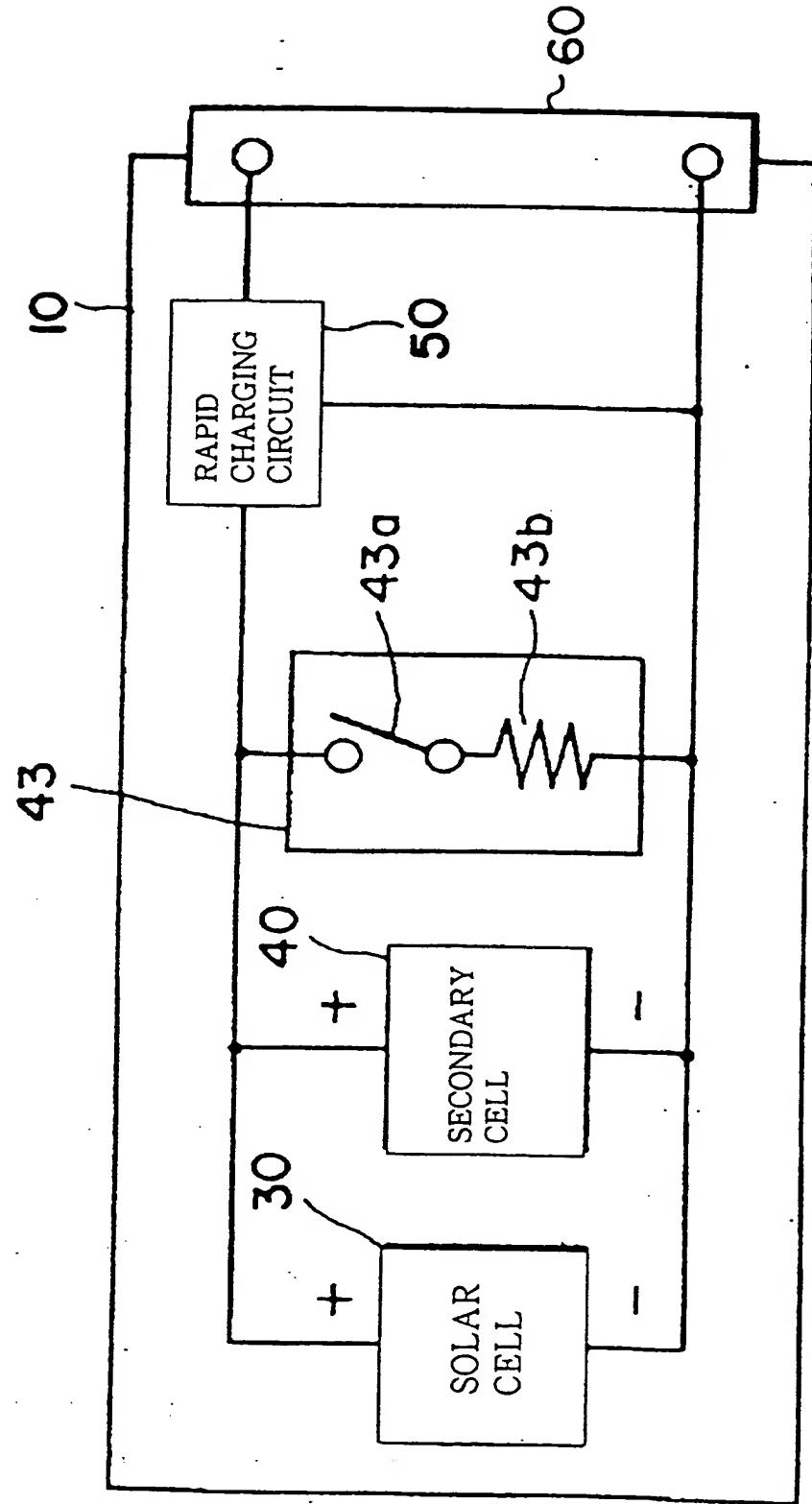


FIG.11

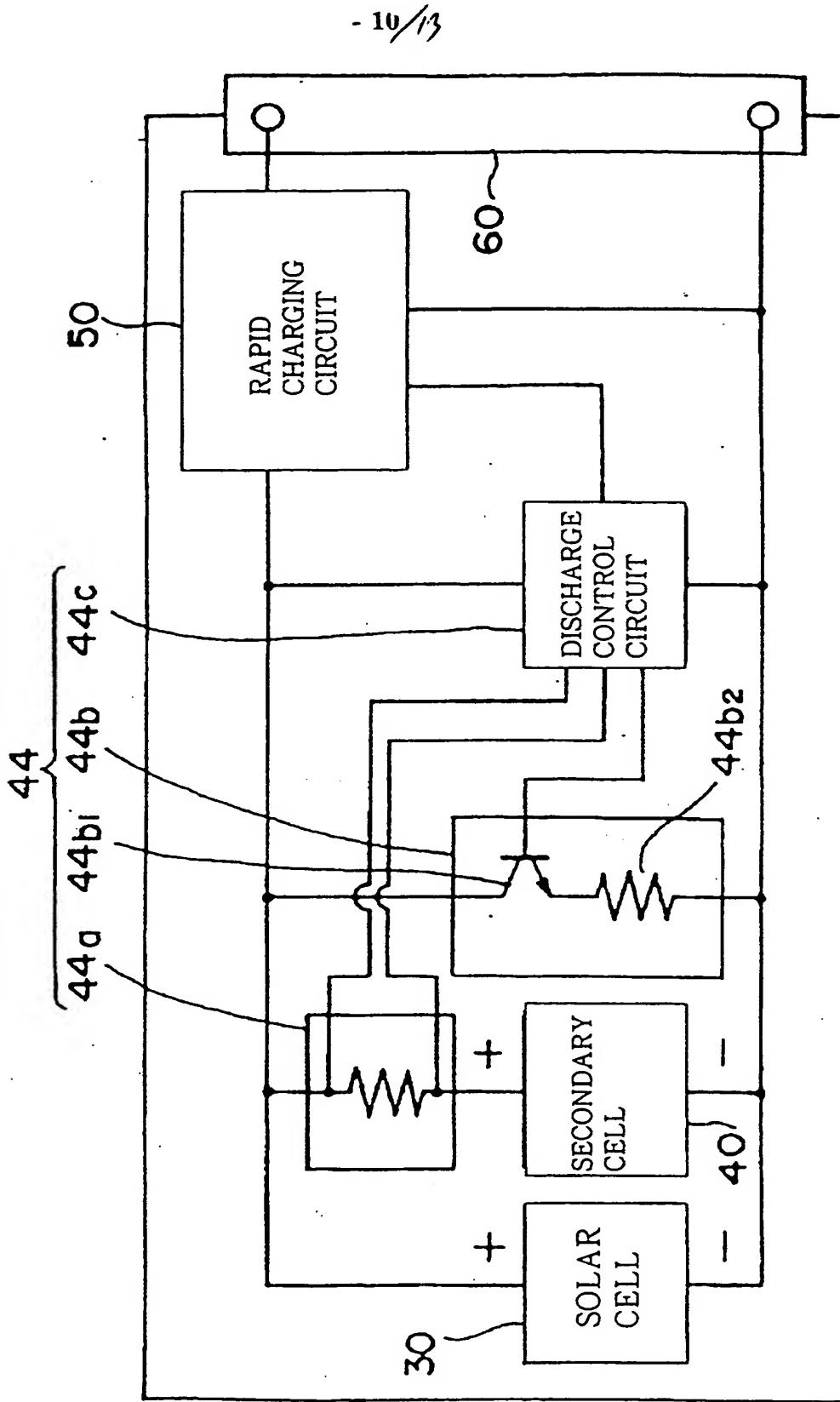


FIG. 12

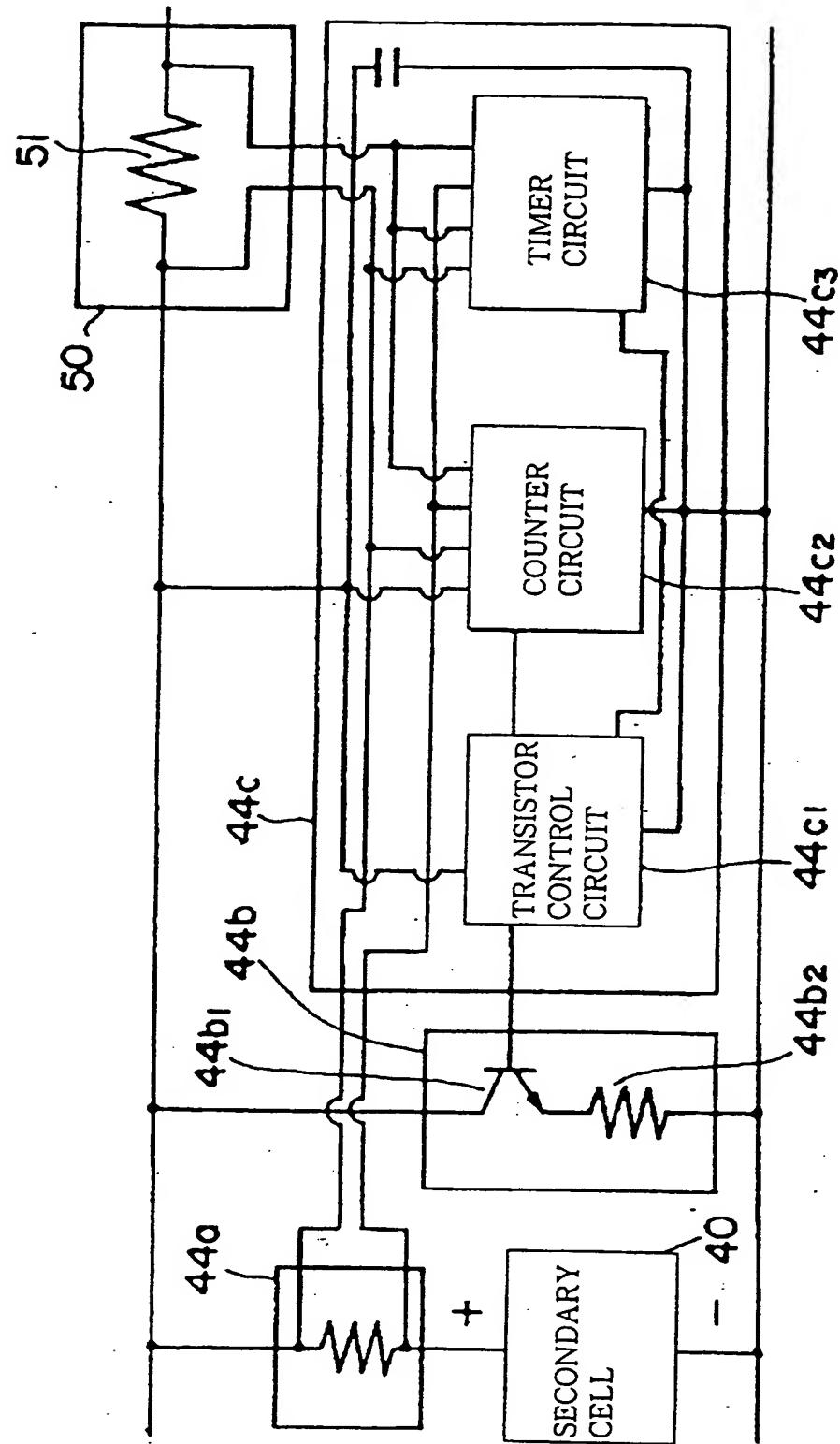


FIG.1.3

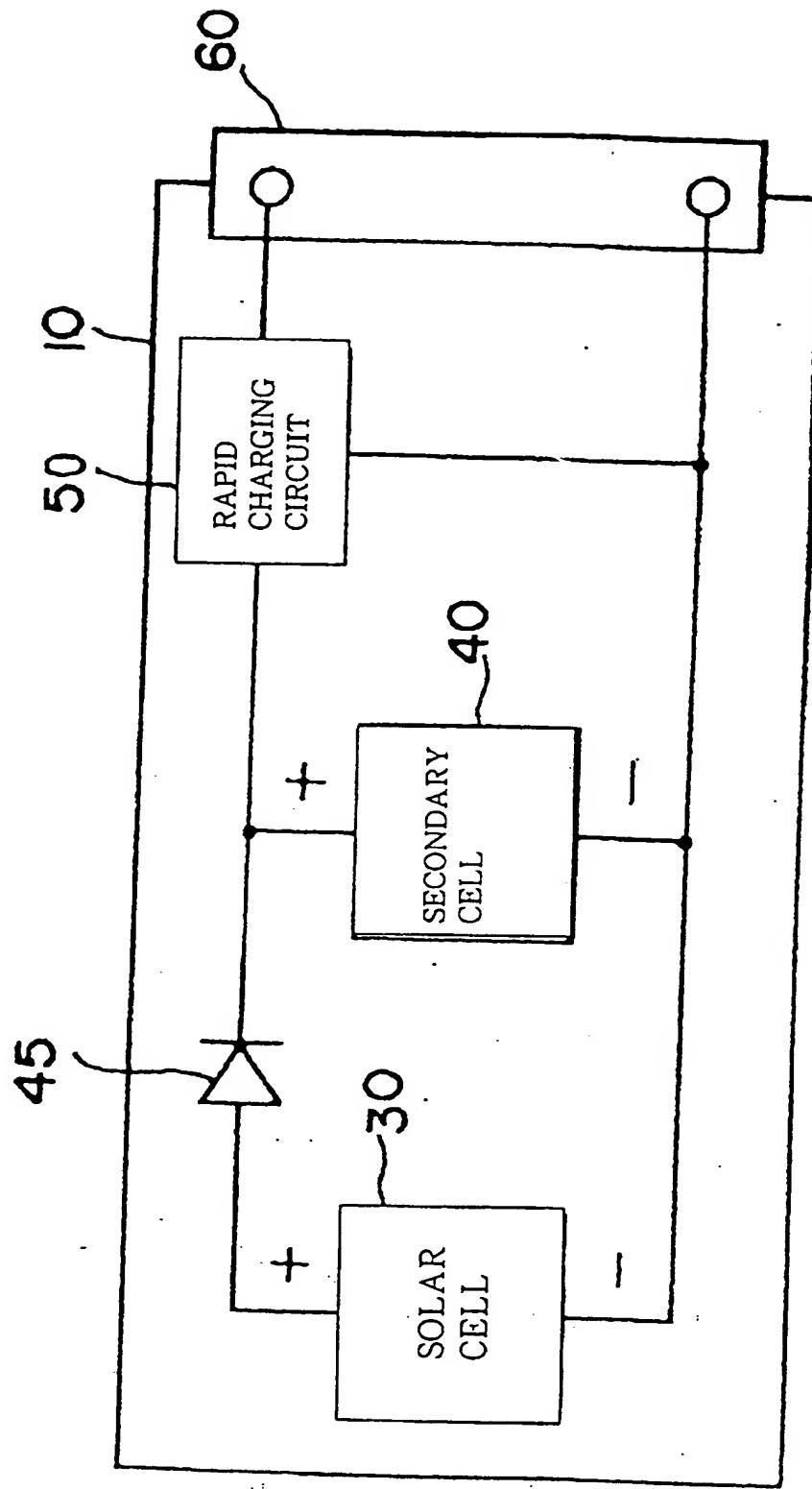
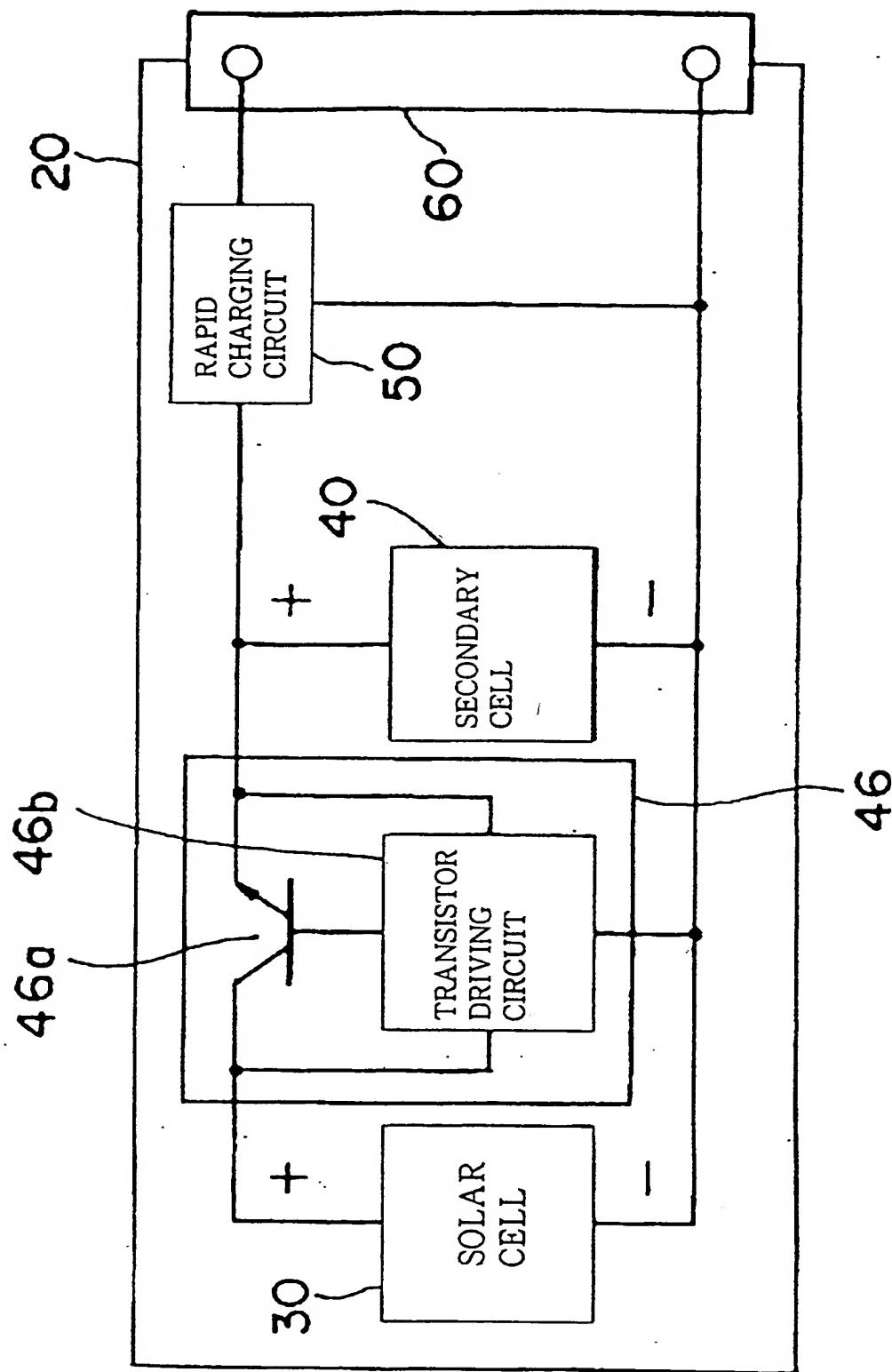


FIG.14



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PORTABLE POWER SUPPLY EQUIPMENT

The present invention relates to portable power  
5 supply equipment for supplying a power source to an electronic device and the like constituted so as to be capable of generating electricity, more particularly to portable power supply equipment which is suitable for a power supply to a portable electronic device.

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For this kind of portable power supply equipment, the portable power supply equipment shown in Fig. 1 has been known.

The portable power supply equipment 1 comprises a solar cell 2 for generating a direct current voltage, a secondary cell 3 for storing electrical energy generated with this solar cell 2, and a connector 4 for supplying the electrical energy stored in the secondary cell 3 to the outside. An electronic  
15 device 5 for receiving the power, such as a portable telephone, a portable communication device or a personal computer, comprises a secondary cell 6 and an electronic circuit 7 functioning as an electronic device. The electronic  
20 device 5 comprises also a power source supply terminal  
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8 in parallel with them.

With this arrangement, the electronic device 5 operates on power supplied from the portable power supply equipment 1 through the secondary cell 6 or the power supply terminal 8.

Moreover, in Japanese Patent Application Laid Open No. Shouwa 63-99733, a further modified portable power supply equipment is disclosed, which comprises a dry cell besides the solar cell to charge the secondary cell 3. In Japanese Patent Application Laid Open No.

10 Heisei 4-340333, a portable power supply equipment is disclosed, which comprises a storage battery and a cell and charges the storage battery as occasion demands.

15 In Japanese Patent Application Laid Open No. Hei 6-22472, a portable power supply equipment is disclosed, in which an output of a solar cell is boosted by a boosting circuit to supply the boosted output to a secondary cell.

20 In the above described portable power supply equipment, the secondary cell is previously charged with electrical energy generated by the solar cell, and power is supplied to an external electronic device from the secondary cell. For this reason, the portable power supply equipment can not be separated from the electronic device during the operation of the electronic device, so that the portability of the electronic

device, fabricated to be small in size and light in weight, must be sacrificed.

Portable power supply equipment disclosed in Japanese Patent Applications Laid Open No. Shou 63-5 99733, No. Hei 4-340333 and No. Hei 6-22472 has the same problem as the foregoing portable power supply equipment.

10 The present invention was made in consideration of the problem involved in the foregoing prior art. The object of the present invention is to realize a portable power supply equipment, which is capable of increasing its facility of use without damaging the portability of a portable electronic device.

15 To achieve the foregoing object, a portable power supply equipment having electric generating means comprises a storage member which is chargeable by the electric generating means, and a rapid charging circuit which rapidly charges an external storage device from 20 the storage member.

According to such constitution of the portable power supply equipment, the storage member is slowly pre-charged by the electric generating means, and the external storage device can be charged through the 25 rapid charging circuit as occasion demands. Therefore,

when a secondary cell installed in the portable electronic device is exhausted, the secondary cell can be rapidly charged. After charging the secondary cell, the portable power supply equipment can be separated from the portable electronic device.

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Since the present power supply equipment and electronic device are a portable type, it goes without saying that they are encased within a case or housing. Moreover, the present portable power supply equipment

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may be utilized not only to charge the external storage device but also to supply power to the portable electronic device including the storage device.

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On the other hand, actually it is also considered that the secondary cell within the portable electronic device can be charged by the conventional portable power supply equipment and the portable electronic device can be used separately from the portable power supply equipment after charging the secondary cell. However, the conventional portable power supply equipment supplies only the power which is usually used by the portable electronic device. The conventional portable power supply equipment takes a long time to charge the secondary cell within the portable electronic device when using this power. Therefore, this conventional port-

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able power supply equipment is not practical. As is disclosed in Japanese Patent Application Laid Open No. Hei 6-22472, if the portable power supply equipment is fitted to a shoulder belt, the power supply equipment 5 is actually usable without separating it from the portable electronic device. However, the portable power supply equipment will have an extremely peculiar external appearance.

Here, for the foregoing electric generating means, 10 it need not be a fixed type generator such as a commercial power generator but it may be a generator which is chargeable for the storage member. For example, it may be a mechanical generator and a solar cell, and further it may be composed of a suitable kind of a fuel 15 cell.

A portable power supply equipment of another embodiment of the present invention constitutes the foregoing electric generating means using a solar cell, in addition to the foregoing constitution.

With the foregoing constitution, by irradiating 20 sun lights or a light having an intensity more than a predetermined value onto the solar cell, light energy is converted to electrical energy, whereby the storage member is charged.

For the solar cell, various kinds of materials 25 such as a single crystal, polycrystalline, non-crystal-

line and compound semiconductor can be used. For example, in case where a crystal type silicon solar cell is employed for the solar cell, a higher photo-electric conversion efficiency compared to that of an 5 amorphous solar cell can be obtained. On the other hand, in case where the amorphous solar cell is employed for the solar cell, a low cost of the solar cell is brought about. This implies not only a reduction in cost of the solar cell but also an increase in a cell 10 size. Therefore, the number of connection portions is reduced thereby reducing also manufacturing cost. In addition, reliability of the solar cell can be realized. Furthermore, in case where an amorphous solar cell is used for the solar cell, the cell exhibits a 15 flexible property, and the cell can be disposed on a curved surface, whereby the solar cell can be worked to any shape.

For the disposition of the solar cell, it suffices that the cell is disposed on the case surface so as to receive light energy supplied from the outside. Moreover, in case where the solar cell is exposed to the air, to coat the surface of the cell with a transparent water repellent material results in increasing its drip-proof property, whereby its safety increases. 20 Moreover, if the solar cell is disposable with a folded and an unfolded state, it can receive the maximum of 25

light energy in its unfurled state. In its folded state, it can be accommodated within the case. Therefore, the required electric generating amount can be secured without damaging portability. In this case, 5 the solar cell may be constituted such that the solar cell itself has an ability to expand and contract. Alternatively, the solar cell may be attached to the surface of a structural body which is capable of expanding and shrinking.

10 On the other hand, for the storage member, various kinds of well known materials can be applied to it, and if the storage member is used for the secondary cell, a lead storage battery, a Ni-Cd battery, a nickel hydrogen battery and a lithium ion battery can be employed. 15 Alternatively, a capacitor of large capacitance may be used.

20 When the storage member is charged from the electric generating means, display means for displaying an operation state of the storage member may be provided. In this case, for a display method for displaying an 25 operation of the storage member, various kinds of methods can be adopted, for example, one for displaying a variation in an energy storage amount in the storage member and one for displaying increase and decrease in the energy storage amount in the storage member.

Furthermore, voltage detection means for measuring

a voltage applied to the storage member may be provided, in order to display either one or both directions of charging and discharging currents to/from the storage member by the change in the application voltage.

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Furthermore, if a light emission diode is arranged between the electric generating means and the storage member, the magnitude of the current flowing through the light emission diode, that is, the magnitude of the charging current to the storage member, is indicated by the light emission intensity of the diode. Furthermore, the states of the storage member indicating whether the storage member is being charged or the charging for it has been completed so that no current flows through it can be also indicated.

As described above, if the present portable power supply equipment is constituted such that the charged amount in the storage member or the increase and decrease in the charged amount is indicated, it will be possible to accurately know the charged amount in the storage member. So by observing

the charged amount in the storage member, it will be possible to judge whether charging of the portable electronic device from the portable power supply equipment is possible or not.

Furthermore, in the portable power supply equip-

ment constituted as described above, the portable power supply equipment of another embodiment of the present invention further comprises a discharging circuit for discharging the foregoing storage member.

5           The discharging circuit, in this case, comprises a charged/discharged state monitoring circuit for monitoring the charged/discharged state of the foregoing storage member to start a discharging operation.

10           In this form of the portable power supply equipment, when the storage member is a secondary cell, a memory effect of the secondary cell can be prevented by forcibly discharging the secondary cell by the discharging circuit. Furthermore, since the charged/discharged state of the storage member is monitored by the charged/discharged state monitoring circuit thereby automatically allowing the storage member to perform a discharge operation, labor to manually operate the discharging circuit can be saved.

15           Some modifications to monitor the charged/discharged state are available. For example, counting means for counting the number of times of the discharging of the storage member may be provided, and a discharging operation may be started after reaching the predetermined number of times of discharging. With timer means, more than one kind of timing among a charging time

to the storage member, a discharging time from the storage member and a sum of the discharging and charging times may be measured, and the discharging operation may be started when the measurement result reaches 5 a predetermined value. Or, combinations of these may be used.

Furthermore, in the portable power supply equipment constituted as described above, the portable power supply of another embodiment of the present 10 invention further comprises a stable charging circuit for stabilizing a charging current to the storage member, the stable charging circuit being arranged between the foregoing electric generating means and the foregoing storage member.

15 The stable charging circuit can be constituted by either a constant current circuit or a constant voltage circuit, which efficiently charges the storage member by controlling the application voltage to the storage member so that the stable charging circuit has an 20 ability to increase the charging efficiency even when charging the secondary cell within the external portable electronic device.

It should be noted that the objects expressed by the word "circuit" should not be limited to things 25 which are composed of a plurality of components, they may be composed of one component as long as it has the

same function as those composed of a plurality of components.

In addition to this, for a concrete means to supply the power to the outside, a plug and a jack of the connector may be disposed in the case, and the plug and the jack may be disposed on the tip portion of the power source cord covered with a flexible resin. When the power source cord is used, fitting of a cord winder in the case enables the power source cord to be wound within the case, thereby further increasing the portability. With the usage of the power source cord, a degree of a freedom at the time of connection is increased and if the power source cord can be housed within the case by the coil winder, the portable power supply equipment will be excellent in portability. Furthermore, the provision of a handle on the case increases the portability.

Various embodiments of the present invention will now be described, by way of example, with reference to the drawings, in which:

Fig. 1 is a block diagram of a conventional portable power supply equipment;

Fig. 2 is a block diagram of a portable power

supply equipment and an electronic device outside it of an embodiment of the present invention;

Fig. 3 is a circuit diagram of a constant current circuit;

5 Fig. 4 is a circuit diagram of a constant voltage circuit;

Fig. 5 is an external perspective view showing a portable power supply equipment embodying the present invention, fitted with a solar cell in an unfurled state;

10 Fig. 6 is an external perspective view showing the portable power supply equipment embodying the present invention, in a state where the solar cell is housed therein;

15 Fig. 7 is an exploded view of a principal portion of the portable power supply equipment showing a constitution of a cord winder;

Fig. 8 is a block diagram of the portable power supply equipment according to another embodiment, which comprises charging amount display means;

20 Fig. 9 is a block diagram of the portable power supply equipment according to further another embodiment, which comprises charging amount display means;

25 Fig. 10 is a block diagram of the portable power supply equipment of another embodiment, which comprises a discharging circuit;

Fig. 11 is a block diagram of the portable power

supply equipment of another embodiment, which comprises a discharging circuit;

Fig. 12 is a block diagram showing a portion of a discharging control circuit;

5 Fig. 13 is a block diagram of the portable power supply equipment according to a still further embodiment, which includes a charged state display means; and

10 Fig. 14 is a block diagram of the portable power supply equipment according to a still further embodiment which includes a stable charging circuit.

15 Fig. 2 is a block diagram showing a constitution of a portable power supply equipment 10 and a portable electronic device 20 of an embodiment of the present invention.

20 The portable power supply equipment 10 is designed such that the equipment 10 is separable from the portable electronic device 20 through a connector 60. In the portable power supply equipment 10, a solar cell 30 serving as electric generating means is electrically coupled to a secondary cell 40 serving as a storage member by respectively connecting their positive poles

and their negative poles. The positive poles of the solar cell 30 and the secondary cell 40 are coupled to a positive pole 61 of a connector 60 through a rapid charging circuit 50, and the negative poles of the 5 solar cell 30 and the secondary cell 40 are coupled to a negative pole 62 of the connector 60. The solar cell 30, the secondary cell 40, and the rapid charging circuit 50 are accommodated within a case 11 (Fig.5), and a connection portion of the connector 60 is exposed at 10 the outside of the case 11.

In this embodiment, a crystal type silicon solar cell is used for the solar cell 30, and a nickel hydrogen cell is used for the secondary cell 40. Furthermore, a connector jack is used for the connector 60. 15 However, they are not necessarily limited to these cells and jack. An amorphous solar cell may be used for the solar cell 30, despite the amorphous solar cell exhibiting a low electric generating efficiency. In a case where the amorphous solar cell is used, 20 the number of connection points per unit area reduces because of an increase in a cell size, thereby increasing reliability.

Moreover, any cell may be used for the secondary cell 40, as long as the cell has an ability to store 25 charges. A lead storage battery, a Ni-Cd battery, a lithium ion battery or a capacitor of large capacitance

can be used for the secondary cell 40.

Furthermore, any connector may be used for the connector 60, as long as it can be

5 electrically connected to the portable electronic device on the outside of the portable power supply equipment. A receptacle and a plug for the connector may be used.

10 Furthermore, a solar cell 30 is used for the electric generating means. However, means such as a manual electronic generator for converting mechanical energy to electrical energy may be also used.

15 The electric device 20 may be a portable telephone, a portable communication device, a personal computer or the like. The electronic device 20 includes a power supply terminal 70 having the ability to receive power from the connector 60 of the foregoing portable power supply equipment 10, and, at the same time, the electronic device 20 includes a secondary cell 80 and an electronic circuit 90 therein. The electronic device 20 is designed such that it is operable by power supplied from the portable power supply equipment 10 through the secondary cell 80 or the power source supply terminal 70. The electronic device 20 may

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be suitably changed as long as the device 20 contains the secondary cell 80 therein.

The rapid charging circuit 50 provided in the portable power supply equipment 10 is constituted such that a large amount of current can be supplied from the solar cell 30 and the secondary cell 40 to the electronic device 20. The secondary cell 80 within the electronic device 20 is constituted such that the secondary cell 80 is rapidly charged in a short time of about one hour. Specifically, when it is assumed that the capacitance of the secondary cell 80 of the electronic device 20 is 1C, the secondary cell 80 is charged, in this rapid charging, to the capacitance of 1C by the charging current flowing through the cell 80 for an hour, whereas, in ordinary charging, the secondary cell 80 is charged to the capacitance of 1C by a charging current of about 1C/10 flowing through the cell 80 for 15 hours.

The rapid charging circuit 50 can be constituted using the constant current circuit shown in Fig. 3 or the constant voltage circuit shown in Fig. 4.

With the constant current circuit shown in Fig. 3, the constant current  $I_0$  determined by the ratio of the voltage across the Zener diode to the resistor  $R$  ( $I_0 = V_z/R$ ) flows successfully through the secondary cell 80.

With the constant voltage shown in Fig. 4, the reference voltage determined by the Zener diode DZ1 and the voltage divided by the resistors R4 and R5 undergoes error amplification, and the output voltage is controlled to be constant using the transistors Tr3 and Tr4.

The constant current circuit and the constant voltage circuit are selectively used or jointly used according to the kind of the secondary cell 40, whereby the secondary cell 80 undergoes the rapid charging for about one hour. These are of course only examples of the rapid charging circuit, and various other kinds of known circuits are applicable to the rapid charging circuit.

Figs. 5 and 6 show external perspective views of the portable power supply equipment 10. As described above, the solar cell 30, the secondary cell 40, the rapid charging circuit 50 and the connector 60 are accommodated within the case 11, and the solar cell 30 and the connector 60 are disposed so as to be exposed at the surface of the case 11.

The solar cell 30 can be disposed either on the outer surface of the case 11 or on the inner surface thereof. When the solar cell 30 is disposed on the outer surface of the case 11, the solar cell 30 is

covered with a transparent water repellent material (not shown), whereby the drip-proof property of the cell 30 can be increased. On the other hand, when the 5 solar cell 30 is disposed on the inner surface of the case 11, a transparent material must be used for at least a portion where the solar cell 30 is disposed, such that solar light is permeable therethrough.

Furthermore, the case 11 comprises a cover portion 12 which is openable in a unfoldable state, which is 10 expandable (see Fig. 5) and contractable (see Fig. 6) with a hinge 13 on the connection portion. When the cover portion 12 is opened fully , the solar cell 30 disposed on the back side is exposed so that the maximum light energy can be received. In this embodiment, the cover portion 12 is openable in the unfoldable state. However, various kinds of known constitutions are available for opening and closing the cover portion, in such manner that, for example, the cover 15 portion is hinged to two portions or the cover portion is hinged along four edges toward the inner side for opening. Furthermore, a handle 14 is fitted to the surface of the case 11 for the convenience to carry it.

In the foregoing embodiment, to supply the power to the outside, the connector 60 is formed on the outer 25 surface of the case 11. However, the power supply equipment may be constituted such that a windable power

source cord is accommodated therein.

Fig. 7 is an external perspective view showing a portable power supply equipment 10 having a cord reeling device. The power source cord 15 is covered with flexible resin, and the tip end is provided with the connector 16. In this embodiment, the plug of the connector is used as the connector 16, and a jack may be also used as the connector 6.

Furthermore, a cord reeling device 17 is fitted to the case 11. This cord reeling device 17 consists of a reel 17a for winding the power source cord 15, a power spring 17b for supplying a rotation power to the reel 17a in a winding direction of the power source cord 15, a stopper 17c which enters a concave portion 17a1 at the periphery of the reel 17a and comes out therefrom thereby freely engaging with the concave portion 17a1, and a reeling button 17d which makes the stopper 17c engage or disengage with the reel 17a when the power source cord 15 is extended or wound.

The power source cord 15 is normally wound by the reel 17a held within the case 11. However, to perform charging operation, the power source cord 15 is pulled out by grasping the connector 16, whereby the reel 17a is rotated while compressing the power spring 17b and the power source cord 15 is drawn out to the required length. At this time, the reel 17a tends to be pulled

back by the power spring 17b. However, the stopper 17c operates like a ratchet and prevents the reel 17a from being wound. When the reel 17a is housed after charging, the reeling button 17d is pushed so that the stopper 17c is relieved from being engaged, and the reel 17a is rotated by the force of the power spring 17b. The power source cord 15 is wound. Thus, the power source cord 15 is not an obstruction for carrying.

10           Charged amount display means for displaying the charging amount can be fitted to the secondary cell 40. Fig. 8 shows the portable power supply equipment 10 comprising this charged amount display means by a block diagram.

15           The current detection circuit 41a is connected between the positive pole of the secondary cell 40 and a wire which connects the positive pole of the solar cell 30 and the positive pole of the connector 60. The current detection circuit 41a is connected to the display section 41c through the display control circuit 41b.

20           The display control circuit 41b serves to compute the current value. The current flowing through the secondary cell 40, which is detected by the current detection current 41a, is sent to the display control circuit 41b, where the current value is computed. The

display section 41c displays the computing result. The current detection circuit 41a consists of a resistor of a low resistance value, which detects the current flowing through the resistor by measuring the potential difference across the resistor. Furthermore, the 5 display control circuit 41b monitors the sign (direction) of the signal from the current detection circuit 41a, and outputs different signals to the display section 41c according to the sign of the signal 10 supplied from the current detection circuit 41a. The display section 41c comprises light emission diodes, each of which emits different color. The display section 41c enables any of the light emission diodes to emit light according to the signal from the display 15 control circuit 41b. Therefore, the operator can judge whether the charged amount (energy charging amount) of the secondary cell 40 is in an increasing state (charged state) or in a decreasing state (discharging state). 20

Furthermore, a signal changing according to the magnitude of the signal from the current detection circuit 41a is outputted from the display control circuit 41b to the display section 41c, as well as the sign of the signal from the current detection circuit 41a. The display section 41c is constituted 25 such that different numbers of the light emission

diodes are allowed to emit light according to the signal from the display control circuit 41b. The display section 41c displays also the increase or decrease of the amount of energy charge  
5 in the secondary cell 40 when the signal is supplied from the display control circuit 41b. Specifically, the display control circuit 41b has the ability to judge the sign of the signal from the current detection circuit 41a and the display section 41c has  
10 the ability to display the magnitude of this current and the magnitude of the increase and decrease of the amount of energy charged.

In this embodiment, light emission diodes are employed for the detection section 41c. However, it  
15 is possible to easily display the change of the energy charge the increase and decrease

of the energy charge also in a case where a voltage meter is employed. Furthermore, the display section 41c may be composed of a digital display device, and the display control circuit 41b may include an A/D converter for converting an analog signal from the current detection circuit 41a to a digital signal, and an integration circuit for integrating the converted value. With such constitution,  
20 the display control circuit 41b outputs the integration value from its integration circuit to the display section  
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41c and the display section 41c displays the integration value. Adoption of such constitution makes it possible to concretely display the energy charge of the secondary cell 40.

5 Fig. 9 is a block diagram of another embodiment showing a constitution of the portable power supply equipment which comprises charge display means.

10 A voltage detection circuit 42a has one terminal connected to the positive pole of the secondary cell 40 and the other terminal connected to the negative pole of the secondary cell 40. The voltage detection circuit 42a outputs the detected signal to display control circuit 42b. The display control circuit 42b is connected to the display section 42c.

15 A potential difference across the secondary cell 40, which is detected by the display control circuit 42b, is transmitted to the display control circuit 42b. In the display control circuit 42b, the integration circuit integrates the voltage values. The display section 42c receives the computed signal and displays it.

20 At the time of computing the voltage value, the display control circuit 42b judges whether the signal indicating the voltage detected by the voltage detection circuit 42a exceeds the voltage value previously

5                   determined by the charge and discharge characteristic of the secondary cell 40. The display control circuit 42b provides different kinds of signals to the display section 42c in accordance with the judging result. The display section 42c comprises at least one light emission diode, and the display section 42c flashes the light emission diode in response to the signal from the display control circuit 42b. This flashing by the light emission diode indicates whether the secondary cell 40 is in a fully charged state or not.

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15                   In this embodiment, the change in the state of the energy charging amount of the secondary cell 40 is displayed by flashing the light emission diode. The constitution in which light emission diodes emitting different colors are turned on to display the change in the state of the energy charging amount of the solar cell 40 may be adopted. Furthermore, the display control circuit 42b may be constituted such that the display control circuit 42b judges the change of the signal from the voltage detection circuit 42a and outputs different signals to the display section 42c in accordance with the judging result. In this case, the display section 42c may be constituted such that the display section 42c flashes the light emission diodes in response to the signal to indicate whether the secondary cell 40 is in a charged state or in a

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discharged state.

In the embodiment shown in Fig. 8, a current detection circuit 41a is employed, and, in the embodiment shown in Fig. 9, a voltage detection circuit 42a is employed. In this embodiment, either the current or the voltage is detected whereby the energy charging state is judged. Detection of either the current or the voltage can be suitably selected in accordance with the kind of the secondary cell 40.

For example, when either a nickel hydrogen battery or a Ni-Cd battery is used for the secondary cell 40, the secondary cell 40 is charged by constant current charging. When a lithium ion battery is used for the secondary cell 40, the secondary cell 40 is first charged by constant current charging and, as the charging proceeds, it

must be switched from constant current charging to constant voltage charging. Therefore, when the lithium ion battery is employed, the current detection circuit 41a and the voltage detection circuit 42a must be jointly used. In this case, precise displaying of the change in the energy charged amount will be possible with accuracy and high convenience.

By the way, a memory effect may occur in the secondary cell 40, so that the secondary cell 40 is not

sufficiently charged. Figs. 10 to 12 show block diagram of a portable power supply equipment comprising a discharging circuit 43 to prevent the memory effect.

5 In the portable power supply equipment shown in Fig. 10, the discharging circuit 43 is composed of a series circuit, which consists of a discharging switch 43a and a resistor 43b. The discharging circuit 43 is connected in parallel to the secondary cell 40. With such constitution, if the discharging switch 43a is 10 closed, the positive and negative poles of the secondary cell 40 are short-circuited through the discharging switch 43a and the resistor 43b, whereby the energy charged in the secondary cell 40 is discharged. The magnitude of the discharging current is determined by 15 the magnitude of the resistance value of the resistor 43b. Therefore, a resistor 43b having a proper resistance value such that the discharging can be performed without causing the memory effect should be selected.

20 On the other hand, in the portable power supply equipment shown in Fig. 11, a discharging circuit 44 is provided, which automatically starts a discharging operation.

25 The discharging circuit 44 consists of a current detection circuit 44a, a main discharging section 44b and a discharging control circuit 44c. The current

detection circuit 44a is composed of a low resistance resistor connected in series with the secondary cell 40.

The main discharging section 44b is connected in parallel to the secondary cell 40 and is composed of a

5 transistor 44b1 and a resistor 44b2, which are connected in series. The discharging control circuit 44c is connected to the current detection circuit 44a, the main discharging section 44b and the discharging control circuit 44c. Here, in the main discharging

10 section 44b, to utilize the transistor 44b1 for a switching operation, the collector and emitter terminals of the transistor 44b1 and the resistor 44b2 are connected in series and the discharging control circuit 44c is allowed to supply a base current to the

15 base terminal of the transistor 44b1.

The discharging control circuit 44c serves to monitor the charged and discharged states of the secondary cell 40. Fig. 12 shows a suitable constitution of the discharging control circuit 44c.

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The discharging control circuit 44c consists of a counter circuit 44c2, a transistor control circuit 44c1, and a timer circuit 44c3. The counter circuit 44c2 counts the number of times the secondary cell 40 is discharged according to the change in the

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value of the current flowing through the secondary cell 40, and the counter circuit 44c2 integrates them and judges whether the integration value exceeds a predetermined numerical value. The transistor control circuit 44c1 controls the base current supplied to the transistor 44b1 of the main discharging section 44b. The timer circuit 44c3 counts the discharging time and the charging time of the secondary cell 40 and integrates them. The timer circuit 44c3 judges whether the integration value of the discharging and charging times exceeds a predetermined time.

The current detection circuit 44a detects the value of the current flowing through the secondary cell 40 and sends the detection result to the counter circuit 44c2. The timer circuit 44c2 counts the number of times the secondary cell 40 is discharged according to the changes in the value of the current flowing through the secondary cell 40. The timer circuit 44c2 integrates them and judges whether the integration value of the number of times of the discharging exceeds a predetermined numerical value. It suffices that the discharging circuit detects the start of the discharging and stores the number of times of discharging in a memory (not shown). It also suffices that the discharging circuit detects the start of discharging by the change in the direction of the current.

Here, if the integration value is below a predetermined numerical value, only the integration is conducted and no subsequent operations are conducted. If the integration value exceeds the predetermined numerical value, the counter circuit 44c2 transmits a predetermined signal to the transistor control circuit 44c1, whereby the transistor control circuit 44c1 elevates the base voltage of the transistor 44b1. Upon the elevation of the base voltage of the transistor 44b1, the transistor 44b1 performs a switching operation so that the path between the collector terminal and the emitter terminal is made conductive. The positive and negative poles of the secondary cell 40 are short-circuited through the transistor 44b1 and the resistor 44b2, whereby the secondary cell 40 is discharged. Furthermore, in the counter 44c2, the counter value is initialized.

In this embodiment, to detect the discharging of the secondary cell 40, the current detection circuit 44a is provided. However, various kinds of methods to detect the discharging circuit may be used. For example, as is shown in Fig. 12, in the rapid discharging circuit 50 arranged between the positive pole of the secondary cell 40 and the positive pole of the connector 60, a resistor 51 is provided within the circuit 60. By measuring the potential difference

across the resistor 51, the discharging of the secondary cell 40 may be detected.

Furthermore, in the foregoing embodiment, the discharging and charging states are monitored using the discharging circuit. However, the discharging and charging states may be monitored by measuring the discharging time and the charging time of the secondary cell 40. In this case, when the discharging time and the charging time of the secondary cell 40 are measured by the timer circuit 44c3, it is, for example, detected based on the direction of the current whether the secondary cell 40 is in the discharging state or not, and only the discharging time may be counted by the timer circuit 44c3 and may be integrated.

Where the portable power supply equipment is constituted as described above, when the current detection circuit 44a detects the current value flowing through the secondary cell 40, the timer circuit 44c3 counts the discharging time of the secondary cell 40 according to the change in the current value and integrates them. Then, the timer circuit 44c3 judges whether the integration value exceeds a predetermined time, for example, 10 hours.

If the integration value integrated by the timer circuit 44c3 exceeds 10 hours, the timer circuit 44c3 transmits a control signal to the transistor control

circuit 44c1, and the transistor control circuits 44c1 elevates the base voltage of the transistor 44b1. Upon the elevation of the base voltage of the transistor 44b1, the transistor 44b1 performs the switching operation so that the path between the collector terminal and the emitter terminal is made conductive. Therefore, the positive and negative poles of the secondary cell 40 are short-circuited through the transistor 44b1 and the resistor 44b2, whereby the energy charged in the secondary cell 40 is discharged. Furthermore, in the counter circuit 44c2, the counting value is restored to an initial value. At the same time, the integration value is restored to an initial value.

In this embodiment, the charging time of the secondary cell 40 is counted and integrated and the main discharging section 44b is operated according to the integration value. Alternatively, either the counting and integration of the charging time of the secondary cell 40 or the counting and integration of the difference between the discharging time and the charging time thereof is performed, and the main discharging section 44b may be operated according to the integration value. Furthermore, when the main discharging section 44b is operated by the combination more than one timing value of the sum of the charging

time and the discharging time or more than one timing value of the sum of the discharging time, the discharging operation most meeting with the discharging characteristic of the secondary cell 40 can 5 be precisely performed.

In the foregoing embodiments, the solar cell 30 and the secondary cell 40 are simply connected in parallel. Charging state display for displaying the charging state may be also interposed in this charging 10 path. Fig. 13 is a block diagram showing another embodiment of a portable power supply equipment.

As shown in Fig. 13, a light emission diode 45 is inserted between the positive pole of the solar cell 30 15 and the positive pole of the secondary cell 40. The light emission diode 45 is disposed such that its light emission portion is exposed to the outer surface of the case 11. The light emission diode 45 is designed such that its light emission intensity changes in accordance 20 with the current flowing therethrough.

Therefore, since the light emission intensity changes depending on the magnitude of the charging current flowing to the secondary cell 40, the user will be able to easily recognize by sight whether the solar 25 cell 30 is generating electricity.

For example, when the secondary cell 40 is fully

charged, little charging current flows even when solar light is irradiated onto the solar cell 30. It is judged that the charging has completed.

Furthermore, when the secondary cell 40 is charged by the solar cell 30, the charging current may be stabilized whereby the secondary cell 40 is precisely charged. Fig. 14 is a block diagram of a portable power source supply equipment comprising a stable charging circuit 46 for stabilizing the charging current.

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The stable charging circuit 46 consists of a transistor 46a and a transistor driving circuit 46b. In the stable charging circuit 46, the path between the collector terminal and the emitter terminal of the transistor 46a is inserted between the positive pole of the solar cell 30 and the positive pole of the secondary cell 40, and the base of the transistor 46a is connected to the transistor driving circuit 46b. The transistor 46a and the transistor driving circuit 46b jointly operate as a constant current circuit. The transistor 46a constitutes the transistor Tr1 shown in Fig. 3.

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More concretely, the collector terminal of the transistor 46a is connected to the positive pole of the solar cell 30, the emitter terminal of the transistor 46a is connected to the positive pole of the secondary

cell 40, and the base terminal of the transistor 46a is connected to the transistor driving circuit 46b. On the other hand, the transistor driving circuit 46b is connected to the positive poles of the solar cell 30 and the secondary cell 40, the negative poles of the solar cell 30 and the secondary cell 40, and the base terminal of the transistor 46a.

In the foregoing constitution, when the solar cell 30 generates electricity, the charging current is constantly supplied to the secondary cell 40, whereby a stable charging is performed.

In order to stabilize the charging current, it is of course possible to adopt a constant voltage circuit. In this case, the constant voltage circuit shown in Fig. 4 may be used.

As described above, in the portable power supply equipment which comprises the solar cell 30 serving as the electric generating means, the secondary cell 40 serving as the storage member, and the rapid charging circuit 50 which rapidly charges the external storage member with electric energy stored therein, the portable power supply equipment is constituted such that electric energy stored in the secondary cell 40 is, in a short time, supplied to the external electronic device 20 by the rapid charging circuit 50, and the secondary cell 80 within the electronic device 20 is

rapidly charged.

As described above, since a large amount of the current is supplied through the rapid charging circuit in a short time, it will be possible to charge, in a short time, the storage member such as the secondary cell in the external portable electronic device, and, after the charging, the portable electronic device is speedily separated from the portable power supply equipment. Thus, the present system is capable of providing portable power supply equipment which does not sacrifice the portability of the portable electronic device and is fabricated to be small in size and light in weight.

To be concrete, when the charged amount of the secondary cell of the portable electronic device reduces while the user has gone out, so that it can not operate, the rapid charging of the secondary cell within the electronic device can be conducted without help of a commercial power source.

Furthermore, by utilizing a solar cell, light energy continuously pouring on the solar cell can be effectively utilized.

Moreover, in case where a discharging circuit for the storage member is employed, a memory effect is prevented so that the storage member can be effectively utilized. In this case, if an automatic operation is

conducted by monitoring the discharging and charging states, labor can be saved. Particularly, when various kinds of method for monitoring the discharging and charging states are combined, the discharging operation 5 can be conducted precisely.

Furthermore, if a stable charging circuit such as the constant voltage circuit and the constant current circuit is arranged between the electric generating means and the storage member, the storage member 10 can be precisely charged.

In summary, where stored electric energy is supplied to an external electronic device, the separation of the electronic device is impossible during the operation of the electronic device, and the portability of the electronic device is damaged. The present invention provides a portable power supply equipment which is capable of increasing convenience without damaging the portability of the portable electronic device. The present power supply equipment consists of a solar cell serving as 15 electric generating means, a secondary cell serving as a storage member, and a rapid charging circuit for rapidly charging an external storage device with stored energy. The electric energy stored in the secondary cell by the rapid charging circuit is supplied in a short time to the external electronic device, and the secondary cell 20 within the electronic device can be rapidly charged.

It will be understood that the present invention has been described above purely by way of example, and modifications of detail can be made within the scope of the invention.

25 Each feature disclosed in the description, and (where appropriate) the claims and drawings may be provided independently or in any appropriate combination.

CLAIMS

1. A portable power supply equipment which has electric generating means comprising:
  - a storage member capable of being charged with said electric generating means; and
  - 5 a rapid charging circuit performing a rapid charging for a storage device which is external from said storage member.
2. A portable power supply equipment according to claim 1, wherein said electric generating means is a solar cell.
3. A portable power supply equipment according to claim 2, wherein said portable power supply equipment further includes a case in which said storage member, said rapid charging circuit and said electric generating means are encased, and said solar cell has a 5 surface coated with a transparent water repellent material and disposed on a surface of said case.
4. A portable power supply equipment according to claim 3, wherein a handle is fitted to a surface of said case.

5. A portable power supply equipment according to claim 1, wherein said electric generating means is a capacitor.

6. A portable power supply equipment according to claim 1, wherein said portable power supply equipment further includes a case in which said storage member, said rapid charging circuit and said electric generating means are encased, and a connector for supplying the power to the outside is formed on an outer surface of said case.

7. A portable power supply equipment according to claim 6, wherein a plug or a jack of said connector is disposed on said case.

8. A portable power supply equipment according to claim 6, wherein a plug or a jack of said connector is disposed on a tip portion of a power source cord covered with a flexible resin.

9. A portable power supply equipment according to claim 8, wherein said case is fitted with a winder in which said power source cord is wound.

10. A portable power supply equipment according

to claim 6, wherein a handle is fitted to a surface of said case.

11. A portable power supply equipment according to any previous claim, wherein said portable power supply equipment further includes display means for displaying an operation state of said storage member.

12. A portable power supply equipment according to claim 11, wherein said display means display a variation in an energy storage amount in said storage member.

13. A portable power supply equipment according to claim 11, wherein said display means display increase and decrease in the energy storage amount in the storage member.

14. A portable power supply equipment according to any previous claim, wherein said portable power supply equipment further includes a discharging circuit for discharging said storage member.

15. A portable power supply equipment according to claim 14, wherein said discharging circuit includes a charging and discharging circuit which monitors

5 charged by said electric generating means and starts a discharging operation.

16. A portable power supply equipment according to claim 15, wherein said charging and discharging circuit includes counting means for counting a number of times of discharging of said storage member, in which a discharging operation may be started after reaching a predetermined number of times of discharging.

5 17. A portable power supply equipment according to claim 15, wherein said charging and discharging circuit includes a timer means for measuring one or more of a charging time to said storage member, a discharging time from said storage member and a sum of said discharging and charging times, in which a discharging operation may be started when the measurement result reaches a predetermined value.

18. A portable power supply equipment according to any previous claim, wherein a stable charging circuit for stabilizing a charging current to said storage member is provided between said electric generating means and said storage means.

19. A portable power supply equipment substantially as herein described with reference to any of Figs. 2-14.



# The Patent Office

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Application No: GB 9709476.7  
Claims searched: 1 to 19

Examiner: M J Billing  
Date of search: 11 July 1997

## Patents Act 1977 Search Report under Section 17

### Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H1B B1046; H2H HAJ, HAK, HBCB, HBCD, HBCE, HBCF, HBCG, HBCH; H4L LECTX.

Int Cl (Ed.6): H01M 10/46; H02J 7/00, 7/10, 7/14, 7/32, 7/34, 7/35, 9/00, 9/04, 9/06; H04B 1/38; H04M 1/72; H04Q 7/32.

Other:

### Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB2238627A (YAZAKI) - Figs40-42	1,2,6,7,14 at least
X	GB2172758A (SHARP) - Fig.1; page 1 lines 120-123	1,2,5 at least
X	GB1254992 (SAFT) - page 2 line 125 to page 3 line 5	1 at least
X	GB1133213 (SACHSELN) - page 3 lines 1-35	1,6,7,14 at least
A	EP0323335A2 (DJELOUAH) - whole document	1-4,6,7, 10-14
X	US5039930 (G & E TEST) - column 2 lines 22-31	1,2,6,811, 12,13 at least
X	US4209346 (KING) - Figs.5,10	1,2,6,7, 11,12,13 at least

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